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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/807,897	03/24/2004	Rong Xiang	TSRI 874.1	6550
7590	05/11/2010		EXAMINER	
OLSON & HIERL, LTD. 36th Floor 20 North Wacker Drive Chicago, IL 60606				SHEN, WU CHENG WINSTON
		ART UNIT	PAPER NUMBER	
		1632		
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/807,897	XIANG ET AL.	
	Examiner	Art Unit	
	WU-CHENG Winston SHEN	1632	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 23 March 2010.
 2a) This action is **FINAL**. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1,26,28 and 53 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1,26,28 and 53 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on 24 March 2004 and 03 June 2004 is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____ .
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)	5) <input type="checkbox"/> Notice of Informal Patent Application
Paper No(s)/Mail Date _____.	6) <input type="checkbox"/> Other: _____ .

DETAILED ACTION

A request for continued examination (RCE) under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 03/23/2010 has been entered.

Claims 2-25, 27, and 29-52 are cancelled. Claim 1 has been amended. Claims 1, 26, 28, and 53 are pending and currently under examination.

This application 10/807,897 filed on March 24, 2004 claims the benefit of 60/457,009 filed on 03/24/2003.

Claim Objections

1. Claim 1 objected to because of the following informalities: The word “and” in the limitation “the attenuated *Salmonella typhimurium* vector comprises and aroA⁻ dam⁻ *Salmonella typhimurium* strain” recited in amended claim 1 filed on 03/23/2010 appears to be a typographic error of “an”. Appropriate correction is required.

Claim 1 filed on 02/04/2010 reads as follows: An oral DNA vaccine suitable for eliciting an immune response against cancer cells in a patient comprising a DNA construct operably encoding at least one survivin protein and one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, wherein the DNA vaccine induces a cytotoxic T-lymphocyte immune response against tumor cells when orally administered to the patient, and the attenuated *Salmonella typhimurium* vector comprises and aroA⁻ dam⁻ *Salmonella typhimurium* strain.

Claim Rejection - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

2. Previous rejection of claims 1, 26, and 53 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, is ***withdrawn*** because claim 1 has been amended and no longer recites “human survivin protein”. Claims 26 and 53 depend from claim 1.

It was noted in the office action mailed on 12/23/2009 that the limitation “the DNA construct operably encoding the survivin protein comprises SEQ ID NO: 3” recited in claims 26 and 53 is the DNA encodes mouse survivin protein (See paragraph [0043] and page 19 listing of SEQ ID. No: 3, US 2004/0192631, publication of instant application).

Claim Rejection - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Previous rejection of claim 1 under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for anti-

tumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), and **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), is **withdrawn** because claim 1 has been amended.

4. Previous rejection of claim 26 under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), and **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), as applied to claim 1 above, and further in view of **Bennett et al.** (Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55; this reference has been provided in the Non-Final office action mailed on 12/13/2006), is **withdrawn** because claim 1 has been amended.

5. Previous rejection of claim 28 under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for

antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), and **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), as applied to claim 1 above, and further in view of **Tanabe et al.** (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, direct submission of DNA sequences of CCL21; this reference has been provided in the Non-Final office action mailed on 12/13/2006), is **withdrawn** because claim 1 has been amended.

6. Previous rejection of claim 53 under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), and **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), as applied to claim 1 above, and further in view of **Bennett et al.** (Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55; this reference has been provided in the Non-Final office action mailed on

12/13/2006), and **Tanabe et al.** (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, direct submission of DNA sequences of CCL21; this reference has been provided in the Non-Final office action mailed on 12/13/2006), is **withdrawn** because claim 1 has been amended.

The following rejections are necessitated by claim amendments filed on 02/04/2010.

7. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for anti-tumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), **Xiang et al.** (Xinag et al., Protective immunity against human carcinoembryonic antigen (CEA) induced by an oral DNA vaccine in CEA-transgenic mice, *Clin Cancer Res.* 7(3 Suppl):856s-864s, 2001), and **Dueger et al.** (Dueger et al. *Salmonella* DNA adenine methylase mutants elicit protective immune responses to homologous and heterologous serovars in chickens, *Infect Immun.* 69(12):7950-4, 2001).

Claim 1 filed on 02/04/2010 reads as follows: An oral DNA vaccine suitable for eliciting an immune response against cancer cells in a patient comprising a DNA construct operably encoding at least one survivin protein and one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, wherein the DNA vaccine induces a cytotoxic T-lymphocyte immune response against tumor cells when orally administered to the patient, and the attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain.

Claim interpretation: The limitation “attenuated *Salmonella typhimurium* vector comprises and aroA⁻ dam⁻ *Salmonella typhimurium* strain” is interpreted as “attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain”.

Haupt et al. teaches that by DNA vaccination for a human cancer patient (See left column, page 228, Haupt et al., 2002), antigen-specific cellular as well as humoral immune responses can be generated. The induction of specific immune responses directed against antigens expressed in tumor cells and displayed e.g., by MHC class I complexes can inhibit tumor growth and lead to tumor rejection (See abstract, Figure1, Haupt et al., 2002). A common strategy to further enhance DNA-based immunization is to employ cytokine genes as adjuvants. (See Table 1, and right column, page 230, Haupt et al., 2002) by linking the cytokine gene directly to the DNA vaccine or inserting DNA coding for an immunomodulatory peptide of a cytokine (See left column, page 231, Haupt et al., 2002). As an example, Haupt et al. discloses that almost all of these carcinomas (i.e. a malignant tumor of epithelial origin) specifically express calcitonin, and calcitonin may represent a suitable target antigen for DNA vaccines. Haupt et al. shows that DNA immunization by gene gun with an expression plasmid encoding the human calcitonin precursor procalcitonin that enables induction of antigen-specific cellular

and humoral immune responses in mice, and co-delivery of a plasmid encoding GM-CSF

increases the efficacy of this DNA vaccine (See left column, page 233, Haupt et al., 2002).

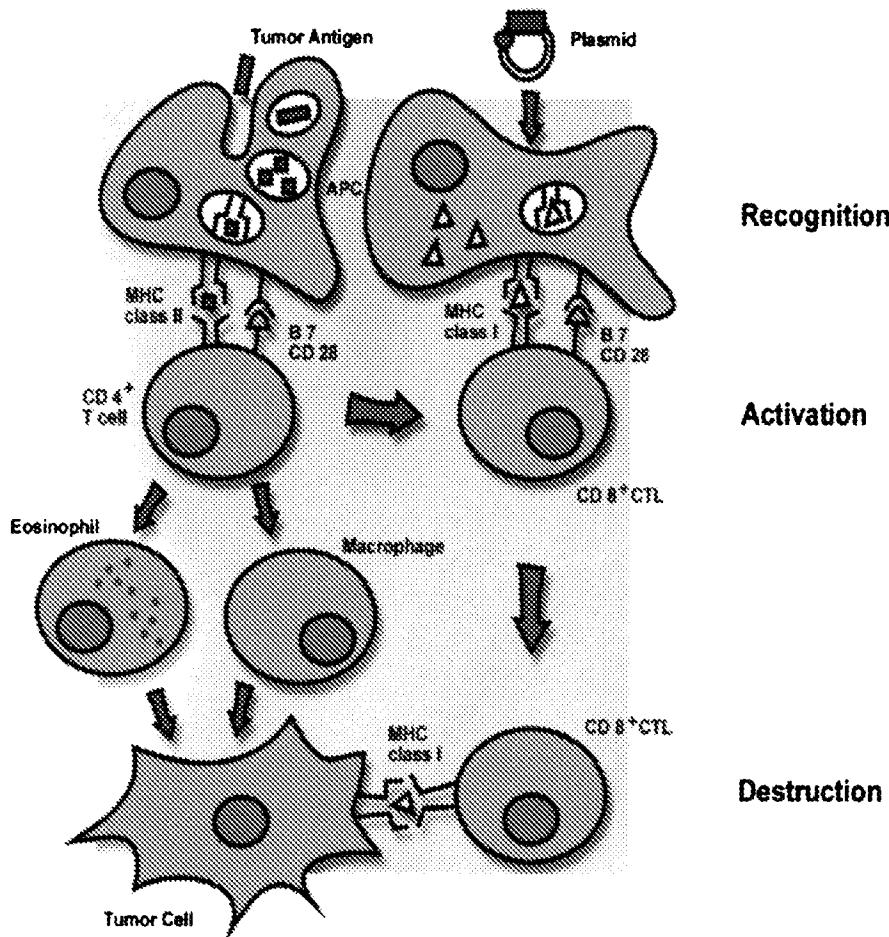


Figure 1. Priming of immune responses against tumor cells by DNA vaccination. The direct inoculation of plasmid DNA encoding a tumor-associated antigen into host cells, including professional APC, leads to the *in vivo* synthesis of the encoded antigen. The intracellular protein is processed into peptides that associate with MHC class I molecules. The MHC class I-peptide complex is displayed on the cell surface where it can be recognized by CD8⁺ T cells. Once activated, CD8⁺ T cells acquire cytotoxic functions and can specifically lyse cells expressing the target antigen. The predominant cell type capable of inducing T cells to become effector cells that can recognize and kill tumor cells following DNA immunization are bone marrow-derived APC. The CD28 molecule on the T cell membrane can interact with costimulatory molecules like B7-1 on APC. Lysis of transfected cells expressing the antigen or secretion of the antigen lead to the release of protein, which is taken up by APC. Internalized into lysosomes, the antigen is proteolytically degraded into peptides that associate with MHC class II molecules. The MHC class II-peptide complexes travel to the cell surface of APC where they can be recognized by CD4⁺ T cells. These cells secrete cytokines that may facilitate tumor cell destruction in the

effector phase of immune responses following DNA vaccination. Tumor-specific CD4⁺ cells not only provide help for the induction of specific CD8⁺ CTL, but may also be critical in activating macrophages and eosinophils to produce nitric oxide and superoxides that participate in the destruction of tumor cells.

Haupt et al. does not teach (i) survivin as a tumor specific antigen, (ii) CCL21 as a cytokine that enhance T cell mediated immune response, or (iii) a DNA construct been incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, and the attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain.

However, at the time of filing of instant application, the art taught that (i) universal tumor antigens, including human survivin, expressed in all tumors but not expressed in non-cancerous tissue, can be used as targets immunotherapy, and (ii) the tumor cell specific immune response can be enhanced by the presence of various cytokines (See, for instance, second paragraph, right column of page 118, Gordan et al., 2002). Furthermore, (iii) the advantages of a vaccine comprising attenuated *Salmonella typhimurium* as a vector to express exogenous antigen(s) that can be delivered orally for vaccination and targets Peyer's patches in the gut, and the attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain, are also known in the art.

(i) Regarding survivin being a universal tumor associated antigens as targets for immunotherapy, **Gordan et al.** teaches that the cardinal feature of universal tumor associated antigen (TAA, also known as tumor specific antigen) is that they are expressed in nearly all tumors but not expressed in non-cancerous tissue , and they are directly involved in the malignant phenotype of the tumor. Gordan et al. teaches that certain peptides derived from such

Ags are expressed on the tumor-cell surface, as evidenced by Ag-specific, MHC-restricted T-cell anti-tumor reactivity. Gordan et al. also teaches that four examples (i.e. a definitive number) of universal tumor Ags (hTERT, CYP1B1, survivin, and MDM2; see left column page 321 and Table 1 page 3232), each at various levels of preclinical and clinical development. Gordan et al. further teaches that features of universal TAA indicate a pre-existing, high-affinity T-cell pool that can be activated *in vivo* in patients, without immunoselection of variant tumor cells no longer expressing the Ag of choice. (See summary of Results and Discussion, page 317, Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002). Consistent with the teachings of Gordan et al., **Andersen et al.** teaches that advances in therapeutic tumor vaccinations necessitate the identification of broadly expressed, immunogenic tumor antigens that are not prone to immune selection. To this end, the human inhibitor of apoptosis, survivin, is a prime candidate because it is expressed in most human neoplasms but not in normal, differentiated tissues. Anderson et al. demonstrates spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo* (See abstract, Andersen et al., 2001).

(ii) Regarding CCL21/SLC (secondary lymphoid tissue chemokine) as a cytokine that specifically enhances T cell mediated immune response, **Luther et al.** teaches that a comparison of CCL19 transgenic mice with mice expressing CCL21 (secondary lymphoid tissue chemokine) revealed that CCL21 induced larger and more organized infiltrates, and a more significant role for CCL21 is also suggested in lymphoid tissues, as CCL21 protein was found to be present in lymph nodes and spleen at much higher concentrations than CCL19 (See abstract, Luther et al.,

2002). Luther et al. teaches that a striking feature of the infiltrates in RIP-CCL21 transgenic mice was the localization of DCs and T cells, but not B cells, close to the chemokine-expressing islet cells., which is exactly the opposing pattern has been previously observed in RIP-CXCL13 transgenic mice, where B cells line the islets and T cells are localized more distantly (See second paragraph, left column, page 426, Luther et al., 2002).

(iii) Regarding the limitation "DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut" and the limitation "attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain", **Lu et al.** (1998) teaches the following: Attenuated *Salmonella typhimurium* has been proposed as one means of providing effective delivery of desired antigens. They provide the advantage that they can be delivered orally. The bacteria grow rapidly and do not require growth in cell culture. Thus, large scale production of vectors, for example, in the use of vaccines, can be accomplished more quickly and easy then where mammalian tissue cultures are required. After oral ingestion, *Salmonella* are concentrated within the liver, spleen, bone marrow, and the Peyers' patches of the gut-associated lymphoid tissue (GALT) (See Abstract, and lines 39-54, column 1, Lu et al., 1998). Lu et al. also teaches that by mutations in regions of a phoP regulatory region repressed gene (prg) or a phoP regulated activated genes (pag), preferably by a deletion, the *Salmonella* is rendered *less virulent*. Preferably, a second mutation in an aromatic amino acid synthetic gene, such as aroA, or aroC/aroD locus is made (See bridging paragraph, columns 5-6, Lu et al., 1998). Consistent with the teachings by Lu et al. **Xiang et al. (2001)** teaches that peripheral T-cell tolerance toward human carcinoembryonic self-antigen (CEA) was broken in CEA-transgenic C57BL/6J mice by an oral CEA-based DNA vaccine. This vaccine, delivered by the

live, attenuated AroA⁻ strain of *Salmonella typhimurium* (SL7207), induced tumor-protective immunity mediated by MHC class I-restricted CD8+ T cells. Additionally, in the context of reducing virulence of *Salmonella typhimurium* as a vector for DNA vaccine, **Dueger et al. (2001)** teaches that *Salmonella* DNA adenine methylase (Dam) mutants that lack Dam are highly attenuated for virulence in mice and confer protection against murine typhoid fever. Dueger et al. (2001) further teaches that a *Salmonella enterica* serovar Typhimurium **Dam⁻** vaccine strain was attenuated for virulence in day-of-hatch chicks more than 100,000-fold, and vaccination of chicks elicited cross-protective immune responses, as evidenced by reduced colonization (10- to 10,000-fold) of the gastrointestinal tract (ileum, cecum, and feces) and visceral organs (bursa and spleen) after challenge with homologous (Typhimurium F98) and heterologous (Enteritidis 4973 and *S. enterica* O6,14,24: e, h-monophasic) *Salmonella* serovars that are implicated in *Salmonella* infection of poultry (See abstract, Dueger et al, 2001).

Therefore, it would have been *prima facie* obvious to one having ordinary skill in the art at the time of the invention to generate a DNA vaccine construct to be incorporated into and orally delivered by attenuated aroA⁻ dam⁻ *Salmonella typhimurium* vector, as taught by Lu et al (1998), Xinag et al. (2001), and Dueger et al. (2001), via combined teachings of (i) Haupt et al regarding the induction of specific immune responses directed against antigens expressed in human tumor cells and displayed e.g., by MHC class I complexes via DNA vaccination of tumor specific antigen and cytokine, (ii) Gordan et al. regarding survivin is one of four of universal tumor Ags (hTERT, CYP1B1, survivin, and MDM2), and Andersen et al. regarding spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, and (iii) Luther et

al. regarding cytokine CCL21 specifically enhances T cell mediated immune response, to arrive at the claimed DNA vaccine that induces a cytotoxic T lymphocyte immune response against tumor cells when orally administering aroA⁻ dam⁻ *Salmonella typhimurium* comprising the DNA vaccine to a patient.

One having ordinary skill in the art would have been motivated to combine the teachings of Haupt et al. (2002) in view of Gordan et al. (2002), Andersen et al. (2001), Luther et al. (2002), Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001), to achieve at a DNA vaccine that induces a cytotoxic T lymphocyte immune response against all tumors because (i) Haupt et al. teaches a DNA vaccine that induces cytotoxic T lymphocyte immune response by expressing various tumor associated antigens (TAAs), which are present in various tumors (i.e. non-universal TAA), and the effect of expression of cytokine in enhancing the efficacy of the DNA vaccine, (ii) Gordan et al. teaches survivin is one of four established universal tumor Ags (hTERT, CYP1B1, survivin, and MDM2), and Andersen et al. regarding spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, (iii) Luther et al. teaches cytokine CCL21, not cytokine CCL19, specifically enhances T cell mediated immune response, and (iv) Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001) teach that the advantage of using aroA⁻ dam⁻ *Salmonella typhimurium* strain exhibiting attenuated virulence comprising the DNA vaccine as a vehicle for targeted delivery of antigen to Peyer's patches in the gut via oral delivery of *S. typhimurium*

There would have been a reasonable expectation of success given (i) successful demonstration of DNA vaccine delivered by gene gun with an expression plasmid encoding the

human calcitonin precursor preprocalcitonin enables induction of antigen-specific cellular and humoral immune responses in mice, and co-delivery of a plasmid encoding GM-CSF increased the efficacy of this DNA vaccine, by the teachings of Haupt et al., (ii) successful identification and validation of survivin as one of four universal tumor associated antigens, by the teachings of Gordan et al., and demonstration of spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, by the teachings of Andersen et al., and (iii) successful demonstration of the effect of CCL21 in specifically increasing T cell mediated cytolytic response, by the teachings of Luther et al., (iv) successful generation of attenuated *Salmonella typhimurium* that can express exogenous antigens and the demonstration of using attenuated *Salmonella typhimurium* for oral vaccination, by the teachings of Lu et al., 1998, and (v) the advantages of using aroA⁻ dam⁻ *Salmonella typhimurium* strain as a DNA vaccine vector in terms of enhanced protective immune response and reduced virulence by the combined teachings of Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001).

Thus, the claimed invention as a whole was clearly *prima facie* obvious.

8. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-

cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), **Xiang et al.** (Xinag et al., Protective immunity against human carcinoembryonic antigen (CEA) induced by an oral DNA vaccine in CEA-transgenic mice, *Clin Cancer Res.* 7(3 Suppl):856s-864s, 2001), and **Dueger et al.** (Dueger et al. *Salmonella* DNA adenine methylase mutants elicit protective immune responses to homologous and heterologous serovars in chickens, *Infect Immun.* 69(12):7950-4, 2001), as applied to claim 1 above, and further in view of **Bennett et al.** (Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55; this reference has been provided in the Non-Final office action mailed on 12/13/2006).

Claim 1 filed on 02/04/2010 reads as follows: An oral DNA vaccine suitable for eliciting an immune response against cancer cells in a patient comprising a DNA construct operably encoding at least one survivin protein and one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, wherein the DNA vaccine induces a cytotoxic T-lymphocyte immune response against tumor cells when orally administered to the patient, and the attenuated *Salmonella typhimurium* vector comprises and aroA⁻ dam⁻ *Salmonella typhimurium* strain.

Claim 26 reads as follows: The DNA vaccine of claim 1 wherein the DNA construct operably encoding the survivin protein comprises SEQ ID NO: 3.

Claim interpretation: The limitation “attenuated *Salmonella typhimurium* vector comprises **and** aroA⁻ dam⁻ *Salmonella typhimurium* strain” is interpreted as “attenuated *Salmonella typhimurium* vector comprises **an** aroA⁻ dam⁻ *Salmonella typhimurium* strain”.

The teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al. and Dueger et al. have been discussed in the preceding section of the rejection of claim 1 under 35 U.S.C. 103(a) as being unpatentable over Haupt et al. (2002) in view of Gordan et al. (2002), Andersen et al. (2001), Luther et al. (2002), Lu et al. (1998), Xiang et al.(2001), and Dueger et al. (2001).

None of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. teaches SEQ ID No: 3 recited in claim 26.

However, at the time of filing of instant application, the DNA construct encoding a murine survivin protein comprising SEQ ID No. 3 recited in claim 26, was known in the art. For instant, **Bennett et al.** teach DNA encoding mouse survivin that identical to SEQ ID NO: 3 (See Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55, detailed alignment of sequences listed below)

RESULT 1

AAS21530
ID AAS21530 standard; cDNA; 955 BP.
XX
AC AAS21530;
XX
DT 21-NOV-2001 (first entry)
XX
DE DNA encoding mouse survivin.
XX
KW Survivin; human; mouse; cytostatic; antisense oligonucleotide;
KW hyperproliferative condition; cancer; apoptosis; cytokinesis; ss.
XX
OS Mus musculus.
XX
PN WO200157059-A1.
XX
PD 09-AUG-2001.
XX
PF 30-JAN-2001; 2001WO-US002939.

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XX
 PR 02-FEB-2000; 2000US-00496694.
 XX
 PA (ISIS-) ISIS PHARM INC.
 XX
 PI Bennett CF, Ackermann EJ, Swayze EE, Cowser LM;
 XX
 DR WPI; 2001-488863/53.
 XX
 PT Novel antisense compounds for modulating the expression of Survivin and
 treatment of cancer.
 XX
 PS Example 13; Page 80-81; 120pp; English.
 XX
 CC The invention relates to antisense oligonucleotides targeted to a nucleic
 CC acid molecule encoding human Survivin, where the antisense
 CC oligonucleotide inhibits the expression of human Survivin. These
 CC antisense oligonucleotides are used in the treatment of an animal
 CC suffering from a disease or condition associated with Survivin, e.g. a
 CC hyperproliferative condition such as cancer, and comprises administering
 CC a therapeutically or prophylactically effective amount of the antisense
 CC oligonucleotide so that expression of Survivin is inhibited. The
 CC oligonucleotides can also be used to treat a human suffering from a
 CC disease or condition characterised by a reduction in apoptosis comprising
 CC administering the antisense oligonucleotide to a human. In addition, the
 CC antisense oligonucleotide and a cytotoxic chemotherapeutic agent e.g.
 CC taxol or cisplatin, can be used to modulate apoptosis, cytokinesis or the
 CC cell cycle, or inhibit the proliferation in a cancer cell by contacting
 CC the cell with the antisense oligonucleotide. AAS21521-AAS21768 represent
 CC Survivin nucleic acids, and antisense oligonucleotides targeted to
 CC Survivin, used in the method of the invention
 XX
 SQ Sequence 955 BP; 230 A; 227 C; 265 G; 233 T; 0 U; 0 Other;

Query Match 100.0%; Score 955; DB 5; Length 955;
 Best Local Similarity 100.0%; Pred. No. 3.6e-284;
 Matches 955; Conservative 0; Mismatches 0; Indels 0; Gaps 0;

Qy 1 GGCACGAGGGGGCCGGGGCTCTCCCGCATGCTCTGGCGCGCCTCCGCCCGCGATT 60
 |||||||
 Db 1 GGCACGAGGGGGCCGGGGCTCTCCCGCATGCTCTGGCGCGCCTCCGCCCGCGATT 60

 Qy 61 TGAATCCTGCGTTGAGTCGTCTGGCGGAGGTTGTGGTACGCCATCATGGGAGCTCCG 120
 |||||||
 Db 61 TGAATCCTGCGTTGAGTCGTCTGGCGGAGGTTGTGGTACGCCATCATGGGAGCTCCG 120

 Qy 121 GCGCTGCCCGAGATCTGGCAGCTGTACCTCAAGAACTACCGCATGCCACCTCAAGAAC 180
 |||||||
 Db 121 GCGCTGCCCGAGATCTGGCAGCTGTACCTCAAGAACTACCGCATGCCACCTCAAGAAC 180

 Qy 181 TGGCCCTTCCTGGAGGACTGCGCCTGCACCCAGAGCGAATGGCGGAGGCTGGCTTCATC 240
 |||||||
 Db 181 TGGCCCTTCCTGGAGGACTGCGCCTGCACCCAGAGCGAATGGCGGAGGCTGGCTTCATC 240

 Qy 241 CACTGCCCTACCGAGAACGAGCCTGATTGGCCAGTGTGTTCTGCTTAAGGAATTG 300
 |||||||
 Db 241 CACTGCCCTACCGAGAACGAGCCTGATTGGCCAGTGTGTTCTGCTTAAGGAATTG 300

 Qy 301 GAAGGCCTGGAACCCGATGACAACCCGATAGAGGAGCATAGAAAGCACTCCCTGGCTGC 360
 |||||||
 Db 301 GAAGGCCTGGAACCCGATGACAACCCGATAGAGGAGCATAGAAAGCACTCCCTGGCTGC 360

 Qy 361 GCCTTCCTCACTGTCAAGAACGAGATGGAAGAACTAACCGTCAGTGAATTCTTGAAACTG 420
 |||||||
 Db 361 GCCTTCCTCACTGTCAAGAACGAGATGGAAGAACTAACCGTCAGTGAATTCTTGAAACTG 420

 Qy 421 GACAGACAGAGAGCCAAGAACAAATTGCAAAGGAGACCAACAAGCAAAAGAGTTT 480

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Db      ||||||| 421 GACAGACAGAGAGCCAAGAACAAATTGCAAAGGAGACCAACAAGCAAAAGAGTT 480
Qy      481 GAAGAGACTGCAAAGACTACCCGTCAAGTCATTGAGCAGCTGGCTGCCTAATGCTGAGCC 540
Db      481 GAAGAGACTGCAAAGACTACCCGTCAAGTCATTGAGCAGCTGGCTGCCTAATGCTGAGCC 540
Qy      541 TTTGCTGAGATAACTTGGACCTGAGTGACATGCCACATCTAAGCCACGCATCCCAGCTT 600
Db      541 TTTGCTGAGATAACTTGGACCTGAGTGACATGCCACATCTAAGCCACGCATCCCAGCTT 600
Qy      601 TCCAGCCAGGGCCTCTAGCAGGACTTAGAGAAGGGAGACAGTGGTATTTGAAACTGGA 660
Db      601 TCCAGCCAGGGCCTCTAGCAGGACTTAGAGAAGGGAGACAGTGGTATTTGAAACTGGA 660
Qy      661 TATCAAATATTTGGTTTGCTTAAAGTGGTACCTCTCTTGGTTTGTGGCTTG 720
Db      661 TATCAAATATTTGGTTTGCTTAAAGTGGTACCTCTCTTGGTTTGTGGCTTG 720
Qy      721 TCTATTGTGACGTGGACTTAAGCAATAAGGAAGTGATGAAGGGACAGTGTCTCTGACAG 780
Db      721 TCTATTGTGACGTGGACTTAAGCAATAAGGAAGTGATGAAGGGACAGTGTCTCTGACAG 780
Qy      781 GACCTGTGGGGTCGGGGTGCCTGTGCAAGGTCTGGTCTGATTGTGATATTCCATAC 840
Db      781 GACCTGTGGGGTCGGGGTGCCTGTGCAAGGTCTGGTCTGATTGTGATATTCCATAC 840
Qy      841 AGGGCTGCTAATGCAGCCCAGGGTAAGTGTGGTTATATGTGTTGTGCTGATAATTG 900
Db      841 AGGGCTGCTAATGCAGCCCAGGGTAAGTGTGGTTATATGTGTTGTGCTGATAATTG 900
Qy      901 TCCTGATGAGTTTCTACCACGGGTAACGGAATAAAATCACTGAAAAAGTGG 955
Db      901 TCCTGATGAGTTTCTACCACGGGTAACGGAATAAAATCACTGAAAAAGTGG 955

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Therefore, it would have been *prima facie* obvious to one having ordinary skill in the art at the time of the invention to incorporate the teachings of Bennett et al. on the DNA encoding mouse survivin, which is identical to SEQ ID NO: 3 recited in claim 26 of instant application, into the combined teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. directing to a DNA vaccine suitable for eliciting a CTL immune response against cancer cells comprising a DNA construct operably encoding at least one survivin protein and at least one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated aroA⁻ dam⁻ *Salmonella typhimurium* vector that targets Peyer's patches in the gut of a patient when the patient is orally vaccinated with the DNA construct.

One having ordinary skill in the art would have been motivated to incorporate the teachings of Bennett et al. on the DNA encoding mouse survivin, which is identical to SEQ ID NO: 3 recited in claim 26 of instant application, into the combined teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al. and Dueger et al. because survivin is conserved in mammals, universally expressed in tumor cells but not in other normal tissues, and SEQ ID No: 3 encodes mouse survivin.

There would have been a reasonable expectation of success given (i) successful demonstration of DNA vaccine delivered by gene gun with an expression plasmid encoding the human calcitonin precursor procalcitonin enables induction of antigen-specific cellular and humoral immune responses in mice, and co-delivery of a plasmid encoding GM-CSF increased the efficacy of this DNA vaccine, by the teachings of Haupt et al., (ii) successful identification and validation of survivin as one of four universal tumor associated antigens, by the teachings of Gordan et al. and demonstration of spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, by the teachings of Andersen et al., and (iii) successful demonstration of the effect of CCL21 in specifically increasing T cell mediated cytolytic response, by the teachings of Luther et al., and (iv) successful generation of attenuated *Salmonella typhimurium* that can express exogenous antigens and the demonstration of using attenuated *Salmonella typhimurium* for oral vaccination, by the teachings of Lu et al., 1998, (v) the advantages of using aroA⁻ dam⁻ *Salmonella typhimurium* strain as a DNA vaccine vector in terms of enhanced protective immune response and reduced virulence by the combined teachings

of Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001), and (vi) DNA encoding mouse survivin was readily available by the teachings of Bennett et al.

Thus, the claimed invention as a whole was clearly *prima facie* obvious.

9. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), **Xiang et al.** (Xiang et al., Protective immunity against human carcinoembryonic antigen (CEA) induced by an oral DNA vaccine in CEA-transgenic mice, *Clin Cancer Res.* 7(3 Suppl):856s-864s, 2001), and **Dueger et al.** (Dueger et al. *Salmonella* DNA adenine methylase mutants elicit protective immune responses to homologous and heterologous serovars in chickens, *Infect Immun.* 69(12):7950-4, 2001) as applied to claim 1 above, and further in view of **Tanabe et al.** (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, direct submission of DNA

sequences of CCL21; this reference has been provided in the Non-Final office action mailed on 12/13/2006).

Claim 1 filed on 02/04/2010 reads as follows: An oral DNA vaccine suitable for eliciting an immune response against cancer cells in a patient comprising a DNA construct operably encoding at least one survivin protein and one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, wherein the DNA vaccine induces a cytotoxic T-lymphocyte immune response against tumor cells when orally administered to the patient, and the attenuated *Salmonella typhimurium* vector comprises and aroA⁻ dam⁻ *Salmonella typhimurium* strain.

Claim 28 reads as follows: The DNA vaccine of claim 1 wherein the DNA construct operably encoding the CCL21 cytokine comprises SEQ ID NO: 7.

Claim interpretation: The limitation “attenuated *Salmonella typhimurium* vector comprises **and** aroA⁻ dam⁻ *Salmonella typhimurium* strain” is interpreted as “attenuated *Salmonella typhimurium* vector comprises **an** aroA⁻ dam⁻ *Salmonella typhimurium* strain”.

The teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al. and Dueger et al. have been discussed in the preceding section of the rejection of claim 1 under 35 U.S.C. 103(a) as being unpatentable over Haupt et al. (2002) in view of Gordan et al. (2002), Andersen et al. (2001), Luther et al. (2002), Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001).

None of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. teaches SEQ ID No:7 recited in claim 28.

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However, at the time of filing of instant application, the DNA construct encoding a murine survivin protein comprising SEQ ID No. 7 recited in claim 28, was known in the art. For instant, **Tanabe et al.** teach DNA encoding mouse CCL21 that is identical SEQ ID NO: 7 (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, detailed alignment of sequences listed below; this reference has been provided in the Non-Final office action mailed on 12/13/2006).

```

RESULT 1
AF006637
LOCUS      AF006637          615 bp      mRNA      linear      ROD 22-JUN-1997
DEFINITION Mus musculus beta-chemokine TCA4 mRNA, complete cds.
ACCESSION  AF006637
VERSION    AF006637.1  GI:2209188
KEYWORDS
SOURCE     Mus musculus (house mouse)
ORGANISM   Mus musculus
Eukaryota; Metazoa; Chordata; Craniata; Vertebrata; Euteleostomi;
Mammalia; Eutheria; Euarchontoglires; Glires; Rodentia;
Sciurognathi; Muroidea; Muridae; Murinae; Mus.
REFERENCE
AUTHORS   Tanabe,S., Lu,Z., Luo,Y., Quackenbush,E.J., Berman,M.A.,
          Collins-Racie,L.A., Mi,S., Reilly,C., Lo,D., Jacobs,K.A. and
          Dorf,M.E.
TITLE      Direct Submission
JOURNAL   Submitted (03-JUN-1997) Genetics Institute, 87 Cambridge Park
          Drive, Cambridge, MA 02140, USA
FEATURES  source          Location/Qualifiers
          1..615
          /organism="Mus musculus"
          /mol_type="mRNA"
          /db_xref="taxon:10090"
          /tissue_type="thymus"
          /dev_stage="adult"
CDS        97..498
          /note="beta-chemokine"
          /codon_start=1
          /product="TCA4"
          /protein_id="AAB61440.1"
          /db_xref="GI:2209189"
          /translation="MAQMMLTLSLLSIVLALCIPWTQGSDGGQDCCLKYSQKKIPYSI
          VRGYRKQEPQLGCPIPAILFSPRKHSKPELCANPEEGWVQNLMRRLDQPPAPGKQSPG
          CRKNRGTSGKGKGSKGCKRTEQTQPSRG"
ORIGIN
Query Match      100.0%;  Score 615;  DB 6;  Length 615;
Best Local Similarity 100.0%;  Pred. No. 3e-193;
Matches 615;  Conservative 0;  Mismatches 0;  Indels 0;  Gaps 0;
Qy      1 GAATTGGCCAAAGAGGCCCTACGGCCAAAGAGGGCTAAACTTGCCTGTCATCTCACC 60
          ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||| |
Db      1 GAATTGGCCAAAGAGGCCCTACGGCCAAAGAGGGCTAAACTTGCCTGTCATCTCACC 60
Qy      61 TACAGCTCTGGTCTCATCCTCAACTCAACCACAATCATGGCTCAGATGATGACTCTGAGC 120
          ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||||| ||||| |
Db      61 TACAGCTCTGGTCTCATCCTCAACTCAACCACAATCATGGCTCAGATGATGACTCTGAGC 120

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Qy	121	CTCCTTAGCCTGGTCTGGCTCTGCATCCCCCTGGACCCAGGCAGTGATGGAGGGGT	180
Db	121	CTCCTTAGCCTGGTCTGGCTCTGCATCCCCCTGGACCCAGGCAGTGATGGAGGGGT	180
Qy	181	CAGGACTGCTGCCTTAAGTACAGCCAGAAGAAAATTCCCTACAGTATTGTCGAGGCTAT	240
Db	181	CAGGACTGCTGCCTTAAGTACAGCCAGAAGAAAATTCCCTACAGTATTGTCGAGGCTAT	240
Qy	241	AGGAAGCAAGAACCAAGTTAGGCTGCCCATCCGGCAATCCTGTTCTCACCCCGGAAG	300
Db	241	AGGAAGCAAGAACCAAGTTAGGCTGCCCATCCGGCAATCCTGTTCTCACCCCGGAAG	300
Qy	301	CACTCTAACGCCTGAGCTATGTGCAAACCCCTGAGGAAGGCTGGGTGCAGAACCTGATGCGC	360
Db	301	CACTCTAACGCCTGAGCTATGTGCAAACCCCTGAGGAAGGCTGGGTGCAGAACCTGATGCGC	360
Qy	361	CGCCTGGACCAGCCTCCAGCCCCAGGGAAACAAAGCCCCGGCTGCAGGAAGAACCGGGGA	420
Db	361	CGCCTGGACCAGCCTCCAGCCCCAGGGAAACAAAGCCCCGGCTGCAGGAAGAACCGGGGA	420
Qy	421	ACCTCTAACGCTGGAAAGAAAGGAAGGGCTCAAGGGCTGCAAGAGAACCTGAACAGACA	480
Db	421	ACCTCTAACGCTGGAAAGAAAGGAAGGGCTCAAGGGCTGCAAGAGAACCTGAACAGACA	480
Qy	481	CAGCCCTCAAGAGGATAGCCCCAGTAGCCCGCTGGAGCCCAGGGAGATCCCCCACGAACCTT	540
Db	481	CAGCCCTCAAGAGGATAGCCCCAGTAGCCCGCTGGAGCCCAGGGAGATCCCCCACGAACCTT	540
Qy	541	CAAGCTGGGTGGTTACGGTCCAACTCACAGGCAAAGAGGGAGCTAGAAAACAGACTCAG	600
Db	541	CAAGCTGGGTGGTTACGGTCCAACTCACAGGCAAAGAGGGAGCTAGAAAACAGACTCAG	600
Qy	601	GAGCCGCTAGTCGAG	615
Db	601	GAGCCGCTAGTCGAG	615

Therefore, it would have been *prima facie* obvious to one having ordinary skill in the art at the time of the invention to incorporate the teachings of Tanabe et al. on the DNA encoding mouse survivin, which is identical to SEQ ID NO: 7 recited in claim 28 of instant application, into the combined teachings of Haupt et al., Gordan et al., Anderson et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. directing to a DNA vaccine suitable for eliciting a CTL immune response against cancer cells comprising a DNA construct operably encoding at least one survivin protein and at least one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated aroA⁻ dam⁻ *Salmonella typhimurium* vector that targets Peyer's patches in the gut of a patient when the patient is orally vaccinated with the DNA construct.

One having ordinary skill in the art would have been motivated to incorporate the teachings of Tanabe et al. on the DNA encoding mouse surviving, which is identical to SEQ ID NO: 7 recited in claim 28 of instant application, into the combined teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. because cytokine CCL21 is known to specifically enhance T cell mediated immune response, and SEQ ID No: 7 encodes mouse CCL21.

There would have been a reasonable expectation of success given (i) successful demonstration of DNA vaccine delivered by gene gun with an expression plasmid encoding the human calcitonin precursor preprocalcitonin enables induction of antigen-specific cellular and humoral immune responses in mice, and co-delivery of a plasmid encoding GM-CSF increased the efficacy of this DNA vaccine, by the teachings of Haupt et al., (ii) successful identification and validation of survivin as one of four universal tumor associated antigens, by the teachings of Gordan et al. and demonstration of spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, by the teachings of Andersen et al., and (iii) successful demonstration of the effect of CCL21 in specifically increasing T cell mediated cytolytic response, by the teachings of Luther et al., (iv) successful generation of attenuated *Salmonella typhimurium* that can express exogenous antigens and the demonstration of using attenuated *Salmonella typhimurium* for oral vaccination, by the teachings of Lu et al., 1998, (v) the advantages of using aroA⁻ dam⁻ *Salmonella typhimurium* strain as a DNA vaccine vector in terms of enhanced protective immune response and reduced virulence by the combined teachings of Lu

et al. (1998), Xiang et al. (2001), and Dueger et al. (2001), and (vi) DNA encoding mouse CCL21 was readily available by the teachings of Tanabe et al.

Thus, the claimed invention as a whole was clearly *prima facie* obvious.

10. Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Haupt et al.** (Haupt et al., The potential of DNA vaccination against tumor-associated antigens for antitumor therapy, *Exp Biol Med (Maywood)*. 227(4):227-37, 2002) in view of **Gordan et al.** (Gordan et al. Universal tumor antigens as targets for immunotherapy, *Cytotherapy*, 4(4):317-27, 2002; this reference has been cited in the office action mailed on 04/25/2008), **Andersen et al.** (Andersen et al., Spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in situ as well as ex vivo in cancer patients, *Cancer Res.* 61(16):5964-8, 2001), **Luther et al.** (Luther et al., Differing activities of homeostatic chemokines CCL19, CCL21, and CXCL12 in lymphocyte and dendritic cell recruitment and lymphoid neogenesis, *J Immunol.* 169(1):424-33, 2002; this reference has been cited in the office action mailed on 07/06/2007), **Lu et al.** (US 5,733,760, issued 03/31/1998; this reference has been cited in the office action mailed on 04/25/2008), **Xiang et al.** (Xinag et al., Protective immunity against human carcinoembryonic antigen (CEA) induced by an oral DNA vaccine in CEA-transgenic mice, *Clin Cancer Res.* 7(3 Suppl):856s-864s, 2001), and **Dueger et al.** (Dueger et al. *Salmonella* DNA adenine methylase mutants elicit protective immune responses to homologous and heterologous serovars in chickens, *Infect Immun.* 69(12):7950-4, 2001) as applied to claim 1 above, and further in view of **Bennett et al.** (Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55; this reference has been provided in the Non-Final office action mailed on

12/13/2006), and **Tanabe et al.** (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, direct submission of DNA sequences of CCL21; this reference has been provided in the Non-Final office action mailed on 12/13/2006).

Claim 1 filed on 02/04/2010 reads as follows: An oral DNA vaccine suitable for eliciting an immune response against cancer cells in a patient comprising a DNA construct operably encoding at least one survivin protein and one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated *Salmonella typhimurium* vector that targets Peyer's patches in the gut, wherein the DNA vaccine induces a cytotoxic T-lymphocyte immune response against tumor cells when orally administered to the patient, and the attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain.

Claim 53 reads as follows: The DNA vaccine of claim 1 wherein the DNA construct operably encoding the survivin protein comprises SEQ ID NO: 3, and wherein the DNA construct operably encoding the CCL21 cytokine comprises SEQ ID NO: 7.

Claim interpretation: The limitation “attenuated *Salmonella typhimurium* vector comprises **and** aroA⁻ dam⁻ *Salmonella typhimurium* strain” is interpreted as “attenuated *Salmonella typhimurium* vector comprises **an** aroA⁻ dam⁻ *Salmonella typhimurium* strain”.

The teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. have been discussed in the preceding section of the rejection of claim 1 under 35 U.S.C. 103(a) as being unpatentable over Haupt et al. (2002) in view of Gordan et al. (2002), Andersen et al. (2001), Luther et al. (2002), Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001).

None of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. teaches SEQ ID No:3 and SEQ ID No: 7 recited in claim 53.

However, at the time of filing of instant application, the DNA construct encoding a murine survivin protein comprising SEQ ID No. 3, the DNA construct encoding mouse CCL21 comprising SEQ ID No: 7, recited in claim 53, were known in the art. For instant, **Bennett et al.** teaches DNA encoding mouse survivin that identical to SEQ ID NO: 3 (See Bennett et al. WO200157059-A1 and U.S. Patent No. 6,335,194, SEQ ID No: 10, columns 27, 53-55, see detailed alignment of sequences listed in the preceding rejection #7), and **Tanabe et al.** teaches DNA encoding mouse CCL21 that is identical SEQ ID NO: 7 (Tanabe et al., direct submission, submitted to Genetics Institute, 87 Cambridge Park Drive, Cambridge, MA 02140, USA, on 03-JUN-1997, detailed alignment of sequences listed in the preceding rejection #8)

Therefore, it would have been *prima facie* obvious to one having ordinary skill in the art at the time of the invention to incorporate the teachings of Bennett et al. on the DNA encoding mouse survivin, which is identical to SEQ ID NO: 3, and the teachings of Tanabe et al. on the DNA encoding mouse CCL21, which is identical to SEQ ID NO: 7, as recited in claim 53 of instant application, into the combined teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. directing to a DNA vaccine suitable for eliciting a CTL immune response against cancer cells comprising a DNA construct operably encoding at least one survivin protein and at least one CCL21 cytokine in a pharmaceutically acceptable carrier; wherein the DNA construct is incorporated in an attenuated aroA⁻ dam⁻ *Salmonella typhimurium* vector that targets Peyer's patches in the gut of a patient when the patient is orally vaccinated with the DNA construct.

One having ordinary skill in the art would have been motivated to incorporate the teachings of Bennett et al. on the DNA encoding mouse surviving, which is identical to SEQ ID NO: 3, and the teachings of Tanabe et al. on the DNA encoding mouse CCL21, which is identical to SEQ ID NO: 7, as recited in claim 53 of instant application, into the combined teachings of Haupt et al., Gordan et al., Andersen et al., Luther et al., Lu et al., Xiang et al. and Dueger et al. because (i) survivin is conserved in mammals, universally expressed in tumor cells but not in other normal tissues, and SEQ ID No: 3 encodes mouse survivin, and (ii) cytokine CCL21 is known to specifically enhance T cell mediated immune response, and SEQ ID No: 7 encodes mouse CCL21.

There would have been a reasonable expectation of success given (i) successful demonstration of DNA vaccine delivered by gene gun with an expression plasmid encoding the human calcitonin precursor preprocalcitonin enables induction of antigen-specific cellular and humoral immune responses in mice, and co-delivery of a plasmid encoding GM-CSF increased the efficacy of this DNA vaccine, by the teachings of Haupt et al., (ii) successful identification and validation of survivin as one of four universal tumor associated antigens, by the teachings of Gordan et al. and demonstration of spontaneous cytotoxic T-cell responses against survivin-derived MHC class I-restricted T-cell epitopes in breast cancer, leukemia, and melanoma patients both *in situ* as well as *ex vivo*, by the teachings of Andersen et al., and (iii) successful demonstration of the effect of CCL21 in specifically increasing T cell mediated cytolytic response, by the teachings of Luther et al., (iv) successful generation of attenuated *Salmonella typhimurium* that can express exogenous antigens and the demonstration of using attenuated *Salmonella typhimurium* for oral vaccination, by the teachings of Lu et al., 1998, (v) the

advantages of using aroA⁻ dam⁻ *Salmonella typhimurium* strain as a DNA vaccine vector in terms of enhanced protective immune response and reduced virulence by the combined teachings of Lu et al. (1998), Xiang et al. (2001), and Dueger et al. (2001), and (vi) DNA construct encoding mouse survivin and DNA construct encoding mouse CCL21 were readily available by the teachings of Bennett et al. and Tanabe et al.

Thus, the claimed invention as a whole was clearly *prima facie* obvious.

Applicant's arguments

Applicant's remarks regarding the previous rejection of record are addressed as the related to the new grounds of rejection set forth above. It is noted that previous four rejections for claims 1, 26, 28, and 53 respectively have been withdrawn. The four new rejections have added Xiang et al. (Xinag et al., Protective immunity against human carcinoembryonic antigen (CEA) induced by an oral DNA vaccine in CEA-transgenic mice, *Clin Cancer Res.* 7(3 Suppl):856s-864s, 2001) and Dueger et al. (Dueger et al. *Salmonella* DNA adenine methylase mutants elicit protective immune responses to homologous and heterologous serovars in chickens, *Infect Immun.* 69(12):7950-4, 2001) to address the amended limitation "the attenuated *Salmonella typhimurium* vector comprises an aroA⁻ dam⁻ *Salmonella typhimurium* strain" filed on 02/04/2010.

The Examiner would like to direct Applicant's attention to recent decision by U.S. Supreme Court in *KSR International Co. v. Teleflex, Inc.* that forecloses the argument that a **specific** teaching, suggestion, or motivation is an absolute requirement to support a finding of obviousness. See recent Board decision *Ex parte Smith*, --USPQ2d--, slip op. at 20, (Bd. Pat. App. & Interf. June 25, 2007) (citing KSR, 82 USPQ2d at 1936) (available at <http://www.uspto.gov/web/offices/dcom/bpai/prec/fd071925.pdf>). The Examiner notes that in the instant case, even in the absence of recent decision by U.S. Supreme Court in *KSR International Co. v. Teleflex, Inc.*, the suggestion and motivation to combine Haupt et al., Gordan

et al., Andersen et al., Luther et al., Lu et al., Xiang et al., and Dueger et al. (and further in view of Bennett et al. and/or Tanabe et al.) have been clearly set forth above in this office action.

It is noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Conclusion

11. No claim is allowed.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication from the examiner should be directed to Wu-Cheng Winston Shen whose telephone number is (571) 272-3157 and Fax number is 571-273-3157. The examiner can normally be reached on Monday through Friday from 8:00 AM to 4:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the supervisory patent examiner, Peter Paras, can be reached on (571) 272-4517. The fax number for TC 1600 is (571) 273-8300.

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Primary Examiner
Art Unit 1632